Classification of NYC Aerosols by X-Ray and Optical Methods

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Purpose

The Principal objective of our work is:

- Elemental Characterization of Aerosols collected by two methods for comparison:
  - EBAM: beta mass attenuation
  - Millipore apparatus: Vacuum Filtration
- Ultimately: to understand how weather patterns affect the chemical composition and darkness of aerosol particles

What are Aerosols?

- Aerosols are small solid or liquid particles suspended in the atmosphere. Their sizes vary from a few nanometers (0.000000001 meters) to almost 100 micrometers (0.0001 m, the thickness of a hair.
    - Volcanic dust
    - Combustion products
    - Soot
    - Smoke

Origin of Aerosols

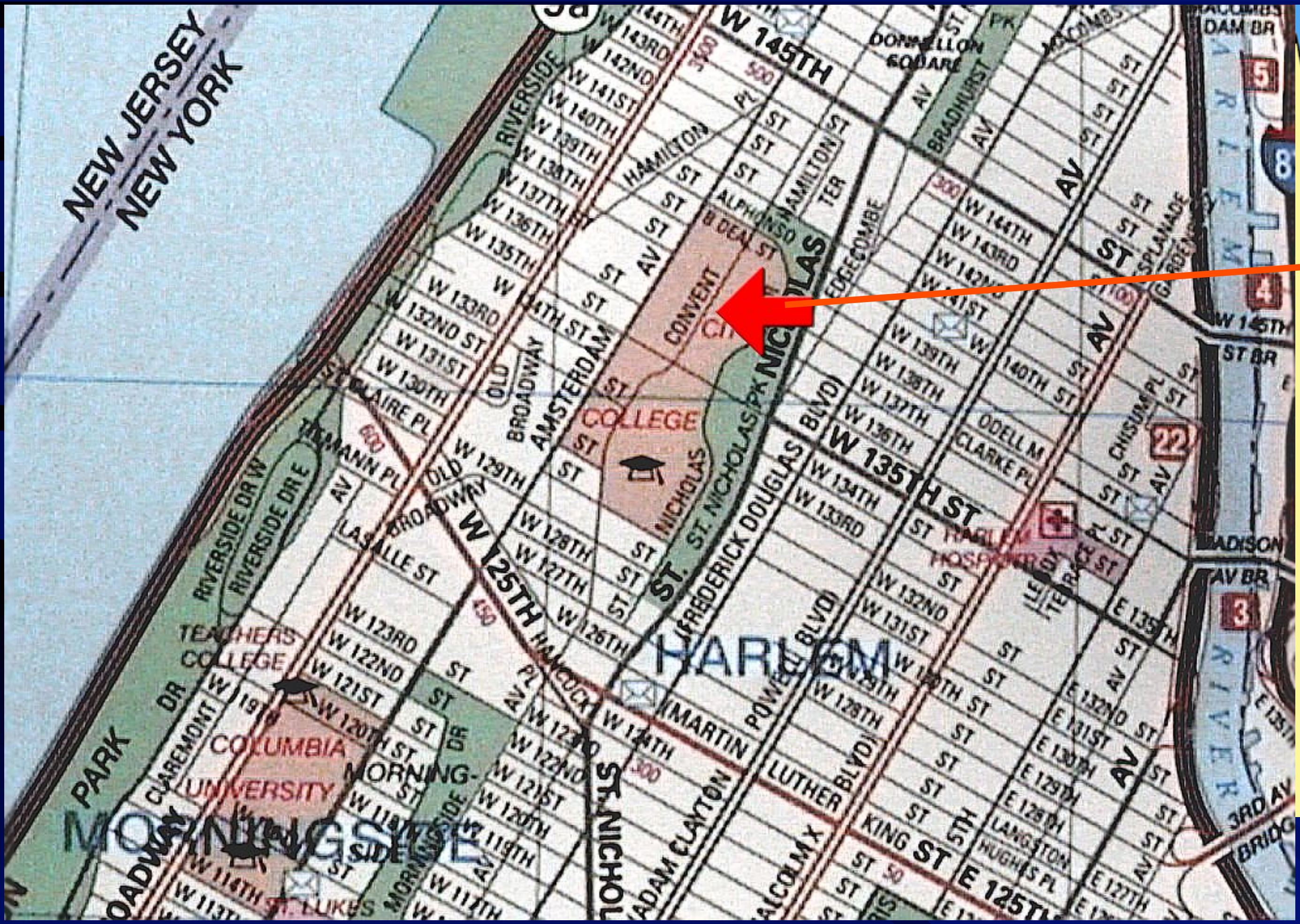
- Aerosols originate both from natural and man-made (anthropogenic) sources . They can be directly emitted as particles (primary aerosols) or they can also be the result of chemical reactions (secondary aerosols).

Why do we study aerosols?

- Health issues: direct relationship between lung diseases
  - Asthma
  - Lung cancer

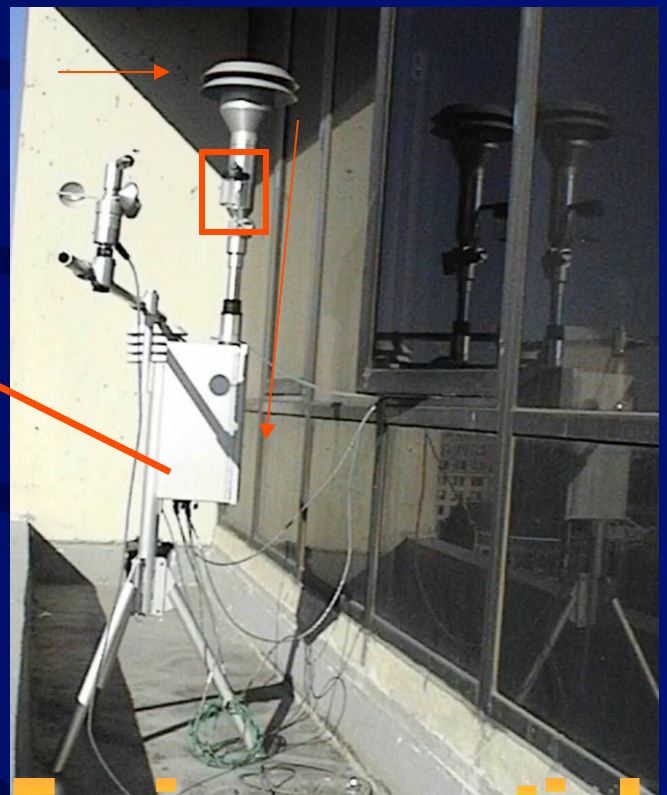
  and particles 2.5 microns and smaller
- Safety and Security: Chemical classification of air masses to be able to recognize unusual or dangerous new patterns

Study Area


NEW JERSEY
NEW YORK
W 145TH
CONVENT
COLLEGE
HARLEM
MORNINGSIDE
COLUMBIA UNIVERSITY
TEACHERS COLLEGE
W 125TH
W 135TH ST
HARLEM HOSPITAL
FREDERICK DOUGLASS BLVD
ST. NICHOLAS
RIVERSIDE DR
HAMILTON TER
EDGECOMBE
AMSTERDAM
BROADWAY


Broadway
W. 207th St/ University Heights
THE BRONX
Macombs Dam
145th St.
Madison Av.
Third Av.
Willis Av.
Wards Island
NEW JERSEY
QUEENS
59th Street
42nd Street
MANHATTAN
BROOKLYN

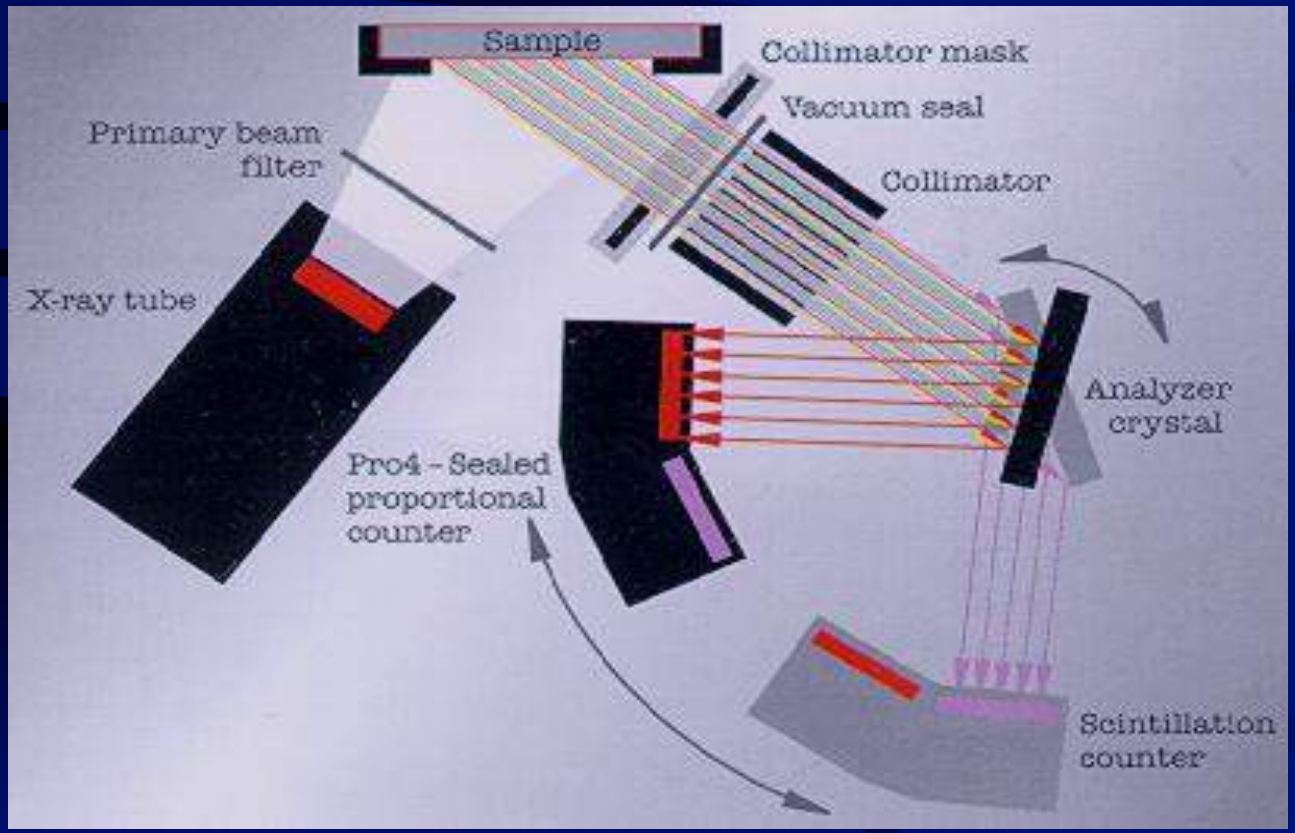
Collection: Environmental Beta Attenuation Mass Monitor (EBAM)



2.5 micron particles

Analytical Methods

- X-RAY Fluorescence Spectrometry (XRF)

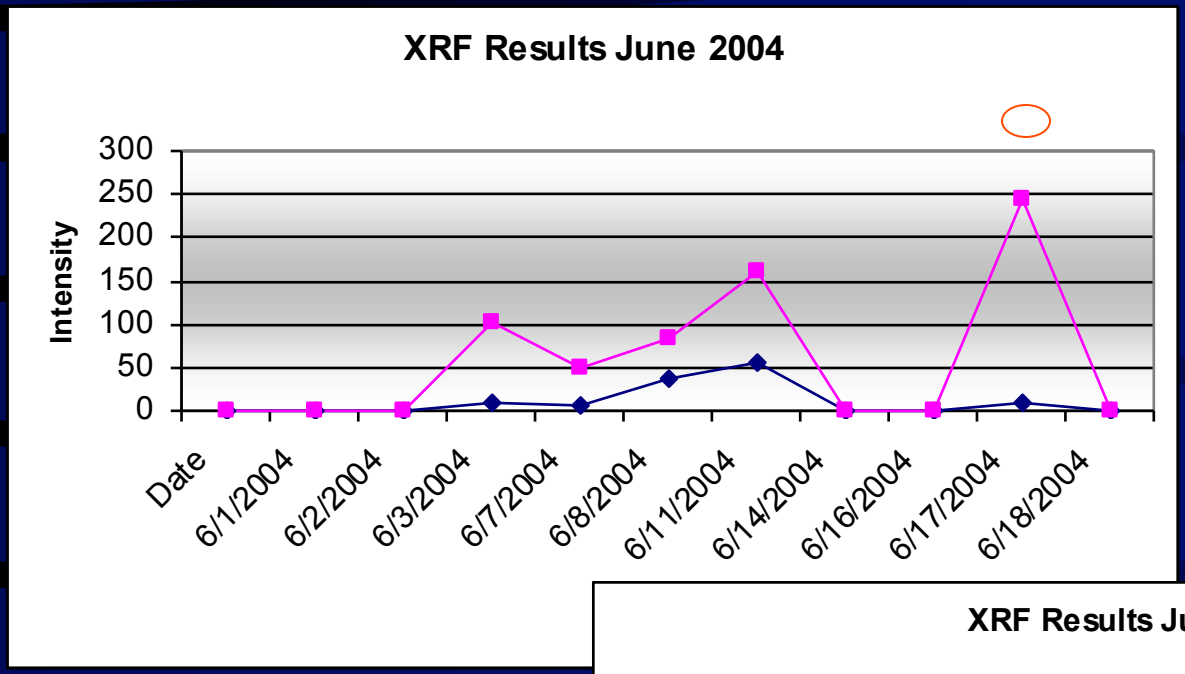


Philips PW 1400 X-Ray Fluorescence Spectrometer (XRF)

Classification by Element Constituents

- Using chemistry and elemental analysis: In particular the following elements:
  - Titanium (Ti)
  - Iron (Fe)
  - Sulfur (S)
- Logic for element selection:
  - Preliminary scans across spectra for all elements shows titanium iron and sulfur in intensities much above background
  - Sulfur compounds are produced through burning of fuels
  - Many elements are potentially harmful to humans especially in particles of 2.5 microns or less

XRF Results


XRF Results June 2004
Intensity
300
250
200
150
100
50
0
Date
6/1/2004
6/2/2004
6/3/2004
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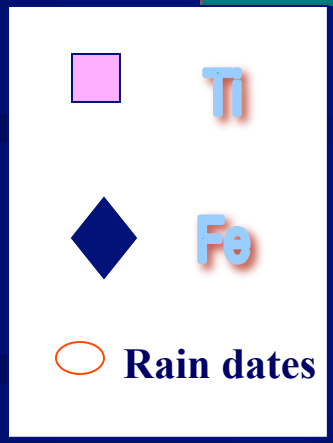
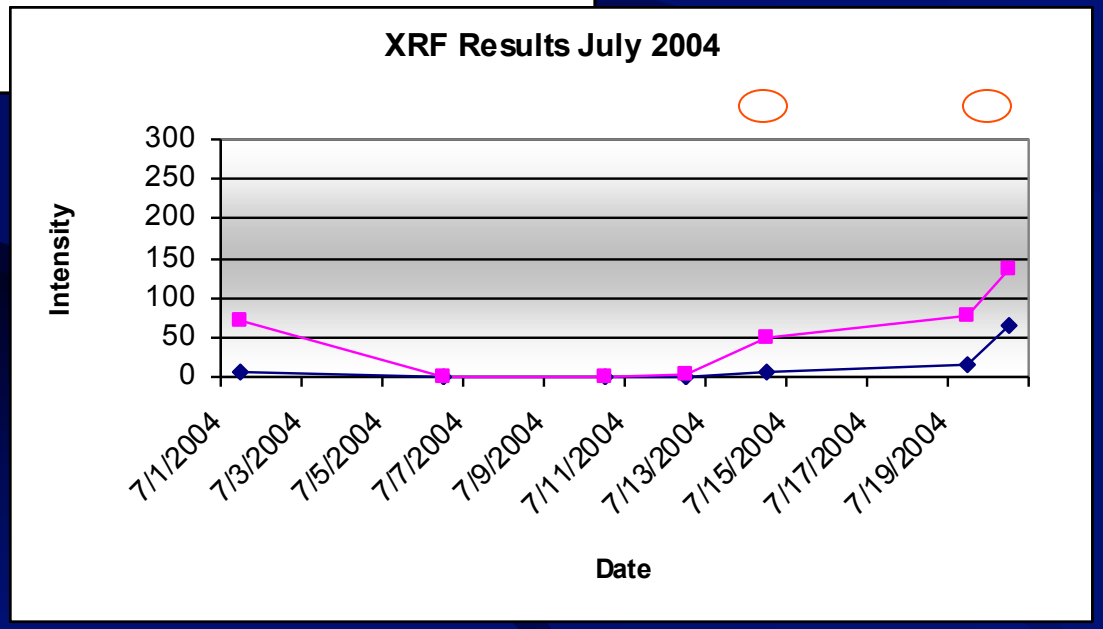
6/8/2004
6/11/2004
6/14/2004
6/16/2004
6/17/2004
6/18/2004


Ti
Fe
Rain dates


XRF Results July 2004
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300
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0
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7/3/2004
7/5/2004
7/7/2004
7/9/2004
7/11/2004
7/13/2004
7/15/2004
7/17/2004
7/19/2004
Date

Characterization by optical properties

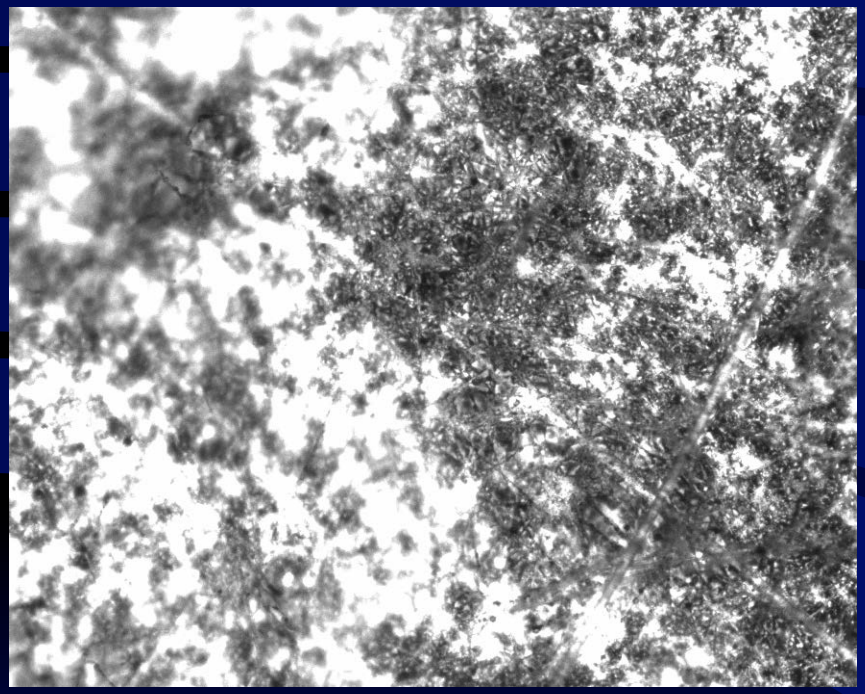
- Correlating sample optical properties (darkness, fluorescence) with chemistry and weather data

Optical Microscopy

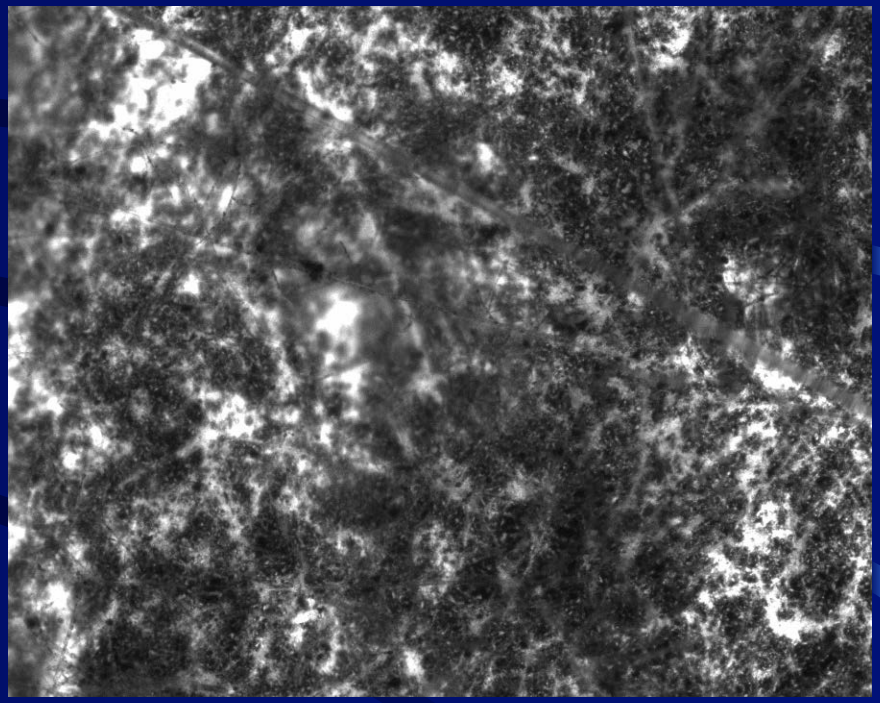
- Why do we use optical microscopy?
  - New approach at characterizing aerosol samples
  - Build upon other experimental work and correlate with XRF techniques and (later down the road…weather data)
- Nikon Fluorescence Microscope with CCD Camera

Optical Results

Ebam filters



July 18, 2004 10X



July 19, 2004 10X

Nikon Fluorescence Microscope with CCD Camera

Conclusion

- Titanium and Iron are present in aerosols in variable and sometimes high concentrations
- At first pass, optical darkness of filters correlates with weather characteristics suggesting that high humidity and rain events correlate with higher concentrations of metals

Further Work

- All data collected will be correlated to weather data, specifically humidity, precipitation and wind direction.
- We hope to be able to characterize aerosol chemistry by back-tracking to determine source.

References

- http://www.atmosphere.mpg.de/enid/n2.html